



## **Innovation-system building, natural resources and economic development – the case of the sugarcane and biofuel industry in Brazil**

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*Publication date:*  
2012

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*Citation (APA):*

Andersen, A. D. (2012). *Innovation-system building, natural resources and economic development – the case of the sugarcane and biofuel industry in Brazil*. Abstract from 14th International Schumpeter Society Conference, Brisbane, Australia.

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*“Innovation-system building, natural resources and economic development – the case of the sugarcane and biofuel industry in Brazil”*

It is argued that in the ‘learning economy’ the international unequal distribution of learning capabilities is the main factor behind differences in wealth and poverty. There is a ‘learning gap’ between developed countries and less developed countries. For less developed countries the only way to close this ‘gap’ is by learning to learn – this can be rephrased as building learning capabilities. Since learning and capability building are systemic processes, building innovation systems is the only way to beneficially participate in the learning economy (Rodrigo Arocena & Sutz, 2000; B. A. Lundvall & Johnson, 1994). Still, both the application of the innovation system approach to less developed countries, and the research area of how to build innovation systems are underdeveloped, and without a broadly-accepted theoretical framework (Bergek, Hekkert, & Jacobsson, 2008; Fagerberg & Srholec, 2008; B.-Å. Lundvall, Joseph, Chaminade, & Vang, 2009; Niosi, 2011). This paper presents a framework for such analysis. In the framework the concept of ‘interactive learning space’ is central (Rodrigo Arocena & Sutz, 2002). It is complemented by a ‘process approach’ where focus is on seven key processes that are of general importance in innovation systems (Bergek et al., 2008; Jacobsson & Bergek, 2006). These concepts represent complementary tools to grasp the evolutionary structural dynamics and process dynamics, and in turn their interaction.

The framework is applied to understand *how* and under which circumstances (*when*) the sugarcane and biofuel-based innovation system was formed and grew in Brazil in the period 1900-2010. The analysis thus contributes to the understanding of innovation-system building in less developed countries.

Moreover, the sugarcane and biofuel production can be characterized as a natural resource-based industry which is often thought to be subject to ‘decreasing returns’, have very few linkages, that innovation and learning is scarce, and that specialization in these industries is equivalent to specializing in poverty – a phenomenon that has been coined the resource curse (Humphreys, Sachs, & Stiglitz, 2007; Reinert, 2007; J. D. Sachs & Warner, 1995). Others have argued that the resource curse is not really about natural resources but about learning – or the absence of it (Rosenberg, 1976; Wright & Czelusta, 1997). Natural resources do not make countries poor, but weak innovation systems do (Dahl Andersen, 2011). This paper gives insight into the only little investigated mechanisms of learning and capability building in natural-resource based industries.

The methodology can be described as a historical, explanatory case study tracing causal relations over time (Yin, 2009). It is based on a single case study which is unique because it is one of those relatively few successful cases of innovation systems in less developed countries which can enrich our understanding of innovation and development. It is moreover a system based on natural resources which makes it even more unique. Sources of information used are scientific works,

reports, websites, and statistical data on several levels, news papers, interviews and field visits. Data was collected during two research stays in Brazil in 2008 and 2010 where 49 interviews were conducted.

The empirical analysis shows that formation and growth of the innovation system was a result of a combination of learning capabilities, learning opportunities and demand structure that interacted with 'external' events. It was characteristic that interactive learning spaces were driven by urgent needs. This generated causal chains of events where key processes stimulated, and were stimulated by, institutional, organizational and technological innovation. The case study supports the 'gardening doctrine' which states that innovation systems cannot be built per se (R. Arocena & Sutz, 2010). Instead, innovation systems should be understood as social organisms that must be nurtured, supported and protected to grow – as delicate flowers in a garden.

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